

JOSHUA FALLS BRIDGE

HAER No. VA-93

(CSX Transportation Bridge No. 1375-A)

Spanning James River at CSX Transportation

2.2 miles north of the junction of U.S. Highway 460
and State Route 726

Lynchburg Vicinity

Campbell County

Virginia

HAER

VA

16-LYNBURY,

1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service

Northeast Region

Philadelphia Support Office

U.S. Custom House

200 Chestnut Street

Philadelphia, P.A. 19106

HISTORIC AMERICAN ENGINEERING RECORD

JOSHUA FALLS BRIDGE
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VA
16-LYNBV.V,
1-

Location: Spanning James River at CSX Transportation
2.2 miles north of the junction of U.S.
Highway 460 and State Route 726, Lynchburg
vicinity, Campbell County, Virginia

USGS Kelly Quadrangle, Universal Transverse
Mercator Coordinates: 17.672240.4142710

Date of Construction: 1901

Contractor: Pencoyd Iron Works

Present Owner: CSX Transportation
500 Water Street, Jacksonville, FL 32232

Present Use: Railroad Bridge (projected date of demolition: Summer 1995)

Significance: The Joshua Falls Bridge is associated with a nationally
significant transportation corridor, the James River of
Virginia. The 1901 five-span Pratt Through Pin Truss
bridge constitutes the only crossing of the James River by
the CSX Transportation rail line between the cities of
Richmond and Lynchburg, and it is the third oldest railroad
bridge in the CSX system in Virginia. The stone piers were
built in 1881 by the Richmond and Alleghany Railroad for
the original bridge at the site; the present bridge
superstructure was erected in 1901 for the Chesapeake and
Ohio Railroad. The Joshua Falls Bridge is considered
eligible for the National Register of Historic Places by the
Virginia State Historic Preservation Office.

Project Information: This documentation was undertaken in September 1993
in accordance with a Memorandum of Agreement by the
U. S. Army Corps of Engineers, the Virginia State
Historic Preservation Officer, the Advisory Council
on Historic Preservation, and CSX Transportation as a
mitigative measure before the demolition of the
Joshua Falls Bridge.

J. Daniel Pezzoni, Preservation Technologies, Inc.
PO Box 7825, Roanoke, VA 24019-0825

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Description

The Setting

The Joshua Falls Bridge spans the James River several miles downstream from the city of Lynchburg, Virginia. The bridge carries the single-track line of CSX Transportation across the river. The rail bed as it crosses the bridge lies at approximately 500' above sea level. The bridge is oriented northeast-southwest, and it crosses a relatively straight stretch of the river at a diagonal. The northeast end of the bridge, located in Amherst County, is situated at the foot of a steep bluff. Approximately three quarters of a mile further to the northeast, along the line in the direction of Richmond, is the now largely abandoned rail depot community of Joshua Falls. The southwest end of the bridge, located in Amherst County, is situated on ground that rises gently to the southwest. Approximately 600' from the southwest abutment of the bridge, the rail line intersects the abandoned bed of the James River and Kanawha Canal. About a half mile further to the southwest is the center of the Babcock & Wilcox Naval Nuclear Research facility. Less than a mile to the southeast of the bridge is the linear ridge of Mount Athos, which rises to 890' above sea level. At the time the present Joshua Falls Bridge was built in 1901, the flat bottoms and rolling high ground above the river would have sustained intensive mixed agriculture. Today, the rich river bottoms remain largely cultivated, whereas the less arable high ground is largely reforested. Aside from the heavy industry represented by the Babcock & Wilcox plant, non-agricultural land use and occupation of the vicinity of the bridge is light. The topographical features described above are portrayed in details of the 1986 Kelly, Va. USGS quadrangle map and a 1916 Chesapeake & Ohio right of way map (included in this report as Figures 1 and 2).

The Bridge

The Joshua Falls Bridge consists of five Pratt Through Pin trusses of soft steel construction supported by stone and concrete abutments and piers. The spans are identifiable as Pratt trusses for their distinctive arrangement of vertical compression members and diagonal tension members. The designations "through" and "pin" refer to the fact that the traffic carried by the spans actually passes through the structure of the truss, and the primary structural members of the spans are connected with pins rather than rivetted plates (Comp and Jackson: 60-61). Four of the bridge's five spans measure 153'-11-7/8" in length (measured from the centers of the end pin connections); the fifth span, located at the west end of the bridge, measures 154'-7-7/8" in length. These spans are unusually long for historic Pratt trusses (Browning: 17). The total length of the bridge, measured from the centers of the east and west end pins, is 781'-3-1/2". Each truss measures 28'-6" in height from the centers of the top and bottom chords.

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The trusses that make up the bridge consist of a number of specialized members. Viewed from the side, the trusses have characteristic trapezoidal profiles created by the inclination of the posts at each end. The end posts are encased in exterior cover plates, which give them a solid appearance, and they have interior lattice reinforcing. Attached to the south end post of the west truss is an uninscribed name plate.

Each pair of end posts is yoked together at the top by portal struts. In the Joshua Falls Bridge, the portals have a distinctive form that relates the bridge to others fabricated by the Pencoyd Iron Works (see historic context). Each portal consists of four panels with diagonal angles forming an "X" separated by vertical angles. The portals have peaked tops and are connected to the end posts with the aid of arched plate brackets. Located along the length of each truss, spanning between the two top chords, are three latticed top struts with knee braces below. The rigidity of the top plane of the truss is further augmented by lateral bracing. The top chords are similar in structure to the end posts (Figs 6, 8 & 9).

The sides of the trusses are formed by vertical latticed posts (or struts) and diagonal eye bars that link the top and bottom chords. (The vertical members at each end of the trusses are also referred to as "hip verticals" or "hangers" in historic construction and repair drawings.) The underside of the truss is formed by intermediate and end stringers running the length of the truss, floor beams (with webs over four feet deep) that span from chord to chord and support the road bed, and lateral bracing. The end of each floor beam, where it sits on the bottom chords and joins to the vertical struts, has a curved cut-away profile that permitted easy access to the pinned joint--another hallmark of the Pencoyd C&O bridges (Spero, 1980: 24-26; see historic context). The single-track road bed consists of creosoted wooden ties and steel rails (Fig. 10).

An important structural feature of the Joshua Falls Bridge is the use of steel pins to join the various members of the truss. At the four top corners of the trusses, these 6-1/4" pins join together the end posts, the top chords, the vertical struts, and the diagonal eye bars. Also of note are the connections between the trusses and the masonry substructure. Fixed shoes alternate with rollers, allowing one end of each truss to shift freely with thermal expansion and contraction and other movement. Traces are still apparent of the red lead paint historically used on the bridge.

The abutments and piers of the bridge were constructed in 1881 and reworked in 1940-1941. The abutments and piers are constructed of a brownish stone, probably sandstone, that was taken from a quarry in present-day downtown Lynchburg. As originally constructed, the piers measured on average 25'-8" wide and 6' thick, and the abutments--which are of the "T" form--measured 5' thick with the stem of the "T" extending into the river bank (Vose: 340). The piers and abutments are battered. In the early 1940s, poured concrete caps were added to the tops of the piers, and the abutments were capped and entirely encased in poured concrete (Figs 4 & 11).

Historic Context

Summary

The Joshua Falls Bridge is associated with a nationally significant transportation corridor, the James River of Virginia. The bridge constitutes the only crossing of the James River by the CSX Transportation rail line between the cities of Richmond and Lynchburg; the location of the crossing was determined by local topography and by the precedence of two earlier transportation systems--the James River and Kanawha Canal and the Richmond & Alleghany Railroad--which crossed the river at or near the same location. The bridge was fabricated in 1901 by the Pencoyd Iron Works for the Chesapeake and Ohio Railway. The five-span Pratt Through Pin Truss structure is supported by stone abutments and piers that were constructed in 1881 for an earlier railroad bridge.

Discussion

The James River ranks among the most historic transportation corridors in the nation (Brown and Woodlief: 1). Native Americans used the river for trade and communication throughout prehistory. The lower reaches of the James River, strategically located near the mouth of the Chesapeake Bay, proved attractive to the English colonists who established Jamestown on an island in the river in 1607. The river acted as a vector of settlement and transportation during the eighteenth century. Richmond was established at the head of ocean-going navigation on the river in the early eighteenth century, and at the end of the century the bustling tobacco mart was chosen as the Virginia state capital. Over a hundred miles upstream from Richmond, the town of Lynchburg was established in 1786 and quickly rose to prominence as the market center for much of Southside and Southwest Virginia. By the turn of the nineteenth century, tobacco and other agricultural products flowed through Lynchburg and other river towns to Richmond and on to domestic and international markets.

In 1785, a group of Virginia entrepreneurs created the James River Company to build a canal up the James and through the Appalachians to the Mississippi drainage. George Washington, the company's first president, saw the project as vital to the economic and political interests of the young United States: "The great object is to connect the Western Territory with the Atlantic States; all others are secondary" (Trout: 2). The James River Company began the monumental task of canal construction and river improvement, but it was not until the second quarter of the nineteenth century that the company's successor, the James River and Kanawha Canal, built a fully operational canal from Richmond to Lynchburg and beyond (ibid.). Construction on the James River and Kanawha Canal was interrupted by the Civil War and by the impoverished years of Reconstruction. Years of hard use and neglect during the war, and a series of devastating

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freshets in the 1870s disrupted the operation of the canal. By the end of the 1870s, it was clear that the canal was no longer viable, and the Virginia legislature authorized its sale to the Richmond and Alleghany Railroad Company (Dunaway: 231-240).

The management and board of directors of the R&A recognized that the course of the canal represented an excellent low-grade connection between the southern Appalachians and the Atlantic seaboard (ibid.: 239; Nelson: 43). Once transfer of the canal works to the railroad company was completed in March 1880, the R&A commenced construction of its line at Richmond. The R&A tracks generally followed the route of the canal tow path, but sharp bends in the path necessitated that an entirely new road bed be constructed for much of the distance between Richmond and Lynchburg (Axtell: 11.13). The canal had hugged the north bank of the James from Richmond to Joshua Falls in extreme northeastern Campbell County; at Joshua Falls the canal boats crossed the river and picked up the canal again on the south bank for the final stretch to Lynchburg. The lock whereby canal boats re-entered the canal on the south bank was located approximately one half mile downstream from the west abutment of the Joshua Falls Bridge. This crossing also allowed the canal to avoid steep topography on the north bank of the river between Joshua Falls and Madison Heights, located across from Lynchburg. Instead of crossing the river at exactly the same location as the canal, the R&A engineers extended their line somewhat further on the north bank before crossing.

On August 4, 1881, the *Lynchburg Virginian* reported that the R&A was essentially finished between Richmond and Lynchburg "with the exception of a bridge a few miles below the city, which is to be completed by the middle of August." The paper assured its expectant readership that work on the line was "being pushed night and day." In its August 18 issue, the *Lynchburg Virginian* announced the completion of the bridge, the antecedent of the present Joshua Falls Bridge. The paper's report contains a wealth of data and is quoted here almost in its entirety:

"THE RICHMOND & ALLEGHANY RAILROAD BRIDGE--The handsome iron bridge of the Richmond & Alleghany Railroad Company, across James river near the Combined Locks, has been completed, and trains have been passing over it for several days. The bridge is composed of five spans, each 150 feet in length, resting on two abutments and four piers of masonry having foundation on solid rock.--The masonry is of the best quality, and the bridge, as it gracefully spans the river, is said to be the handsomest in Virginia.

"The stone for the masonry was gotten from the quarry owned by Davies and Patterson of this city. The quarry is situated on Fishing creek, about one mile from the city, near the Virginia Midland Railroad.--The stone was hauled on cars to the switch near the canal and then transferred to boats on which it was transported down the canal to the site of the bridge.

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"The Central Bridge Company, with offices at 52 Wall Street, New York, and works at Buffalo, New York, were contractors and builders of both masonry and bridge. Their works are among the largest in the country, and they are contemplating an additional department for the building of iron vessels. Their outfit for quarrying and laying stone is pronounced by experienced workmen to be most ample and complete--the derricks for quarrying and laying stone being worked by steam power."

The article went on to note that the Central Bridge Company was building a four-span iron bridge at Rope Ferry above Lynchburg (near the present-day community of Snowden) that was the "duplicate" of the Joshua Falls Bridge. The Rope Ferry Bridge used stones taken from the canal locks and dam at Cushaw Falls.

The quarry that supplied the stone for the piers and abutments of the original (and present) Joshua Falls Bridge was operated by Samuel Patterson and Addison M. Davies. Patterson was a Lynchburg stoneworker and contractor (Lynchburg Virginian, "Belgian": 40). Davies, according to his advertisements in Lynchburg business directories of the period, was a broker who bought and sold "notes, bonds, bills, claims, coupons, railroad tickets, gold, silver," and in 1881 he was president of the Bedford Alum and Iron Springs Company, a summer resort near Lynchburg (Noble: 28). Patterson and Davies appear to have gone into partnership in May 1880, shortly after Patterson purchased an 84-acre tract near the confluence of Fishing Creek and the James River on the southern outskirts of Lynchburg (Campbell County Deed Book 43, p. 90). Two agreements between Patterson and Davies dated June and September 1880 refer to a "stone mill" and to three quarries "now opened" on the tract, and suggest that the quarrying operation relied on water power (Campbell County Deed Book 41, pp. 202 & 320). In 1880, Davies and Patterson tried unsuccessfully to obtain street paving contracts with the city of Lynchburg. By 1882, Davies was out of the quarrying business and he had apparently left Lynchburg under a cloud as a consequence of financially ruinous developments in other arms of his business enterprise (Lynchburg Virginian, "Belgian"; Noble).

The 1881 stonework taken from the Davies & Patterson quarries survives at Joshua Falls Bridge, but the original bridge superstructure was removed in 1901, as explained in greater detail below. The appearance of the original superstructure would be unknown was it not for a remarkable collection of Richmond & Alleghany Railroad construction photographs preserved by the Jones Memorial Library in Lynchburg. Although a photograph of the Joshua Falls Bridge is not included in this collection, a photograph of its "duplicate"--the Rope Ferry Bridge--is. The Rope Ferry Bridge consisted of four Pratt Through Pin Trusses with iron plate-covered inclined end posts and top chords, wide laced portal struts and narrower laced lateral struts, laced intermediate posts, and rod-like hip verticals and diagonals (Fig. 12). The three-span Snowden Bridge, located near the Rope Ferry Bridge, was similar in construction to the Rope Ferry and Joshua Falls bridges (as indicated by two surviving photographs).

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The original Joshua Falls Bridge was acquired by the Chesapeake and Ohio (C&O) Railroad along with other assets of the R&A in 1890. The C&O system had grown to become one of the largest rail networks in the Eastern United States by the end of the nineteenth century, and an important link between the Ohio River basin and the Eastern Seaboard. The R&A line along the James River offered the C&O a low-grade route from the coal fields of the southern Appalachians to the Chesapeake Bay, "relieving the necessity of The C&O hauling its heavy freight over its Blue Ridge Mountain line with heavy grades" (Nelson: 43).

Around 1900, the C&O embarked on an ambitious program of replacing its iron bridges with steel spans. The company's shift to steel was part of a nation-wide trend. American bridge engineers began to experiment with steel in the 1870s; by the late 1880s, steel gained parity with wrought iron in the manufacture of most bridge components. By the mid-1890s, "it was practically impossible to obtain wrought iron shapes" (*Engineering News*, v. 47 n. 26 [June 26, 1902]: 516; Spero, 1979: 8). For the C&O, the switch to steel allowed "the substitution of heavier bridges for many that were too light for the larger engines and cars" (Axtell: 12.25).

The 1901 C&O annual report noted that "Three iron bridges, consisting of fourteen spans, 1,695 lineal feet, have been replaced by new steel structures capable of carrying the heaviest equipment." The Joshua Falls Bridge was among these three bridges. (Since 1901 the bridge has typically been referred to as "Bridge 1375-A, Joshua Falls, Virginia" on C&O drawings; the name is usually shortened by CSX Transportation to "Joshua Falls Bridge" [Galloway]. The bridge is also occasionally referred to as the "Ninemile Bridge.") The new bridge, consisting of five Pratt Through Pin trusses, was built on the stone abutments and piers of the original bridge. The construction drawings for the bridge identify its fabricator as the Pencoyd Iron Works of Pencoyd, Pennsylvania.

In 1900, the Pencoyd Iron Works had forty-eight years of experience in metalworking and eleven years in the production of open-hearth steel. The Pencoyd works were located near downtown Philadelphia and were operated as a subsidiary of the A. & P. Roberts Company. By the turn of the century, Pencoyd had become a leading national and international fabricator of steel bridges, train sheds, elevated railroads, and other structures. Pencoyd also led in technological innovation; in 1899 it adopted a "process for the continuous production of open-hearth steel," which it claimed produced higher yields per ton of ore than the Bessemer process. About 1902, thirty-five independent bridge companies including the Pencoyd Iron Works were acquired by the American Bridge Division of U. S. Steel (*Engineering News*, v. 40 n. 13 [September 29, 1898]: 194-197; v. 46 n. 2 [July 12, 1900]; v. 48 n. 7 [August 14, 1902]; *Railway Age*, v. 37 n. 4 [January 22, 1904]: 139; Deihler: 15, 24, 40; Tarbell: 102-105).

The Joshua Falls Bridge is structurally related to a one-span truss located on the abandoned Craig Valley line of the C&O Railroad in Botetourt County, Virginia. This Pratt Through Pin Truss bridge was assembled by the A. & P. Roberts Company out of Pencoyd components in 1901.

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Like the Joshua Falls Bridge, the Botetourt County truss features peaked portals reinforced by four cross panels and arched brackets, laced lateral struts and intermediate posts of similar design, and curved floor beam ends (Spero, 1980: 24-26). Two Pratt Through Pin Truss bridges fabricated by the Pencoyd Iron Works and constructed in 1899 survive on the C&O line in Alleghany County, Virginia (Browning: 28-29).

The Joshua Falls Bridge has been repaired repeatedly since 1901. In 1925 a number of counters (diagonal members) and top strut lattice bars were replaced; ten years later a substantial number of eye-bars were replaced. Drawings for the 1935 repairs specified the use of turnbuckles that were to be "American Bridge Company's standard or equal," suggesting the repairs for 1935 and perhaps also 1925 may have used American Bridge Company parts. In 1940 and 1941, the abutments at each end of the bridge were encased in poured concrete, and concrete pads were added to the tops of the stone piers. Minor repairs were made to the bridge in 1966 after it was damaged in an accident. Aside from the 1940s work, the repairs to the bridge have not altered its appearance, since damaged components were replaced in kind.

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E. Under-investigated sources.

Chesapeake and Ohio Railway Company. Papers. Location: Chesapeake and Ohio Historical Society, Clifton Forge, Virginia. Although these papers were perused for information on the Joshua Falls Bridge, the sheer volume of the collection and the lack of any guide or cataloguing system made a thorough investigation impossible.

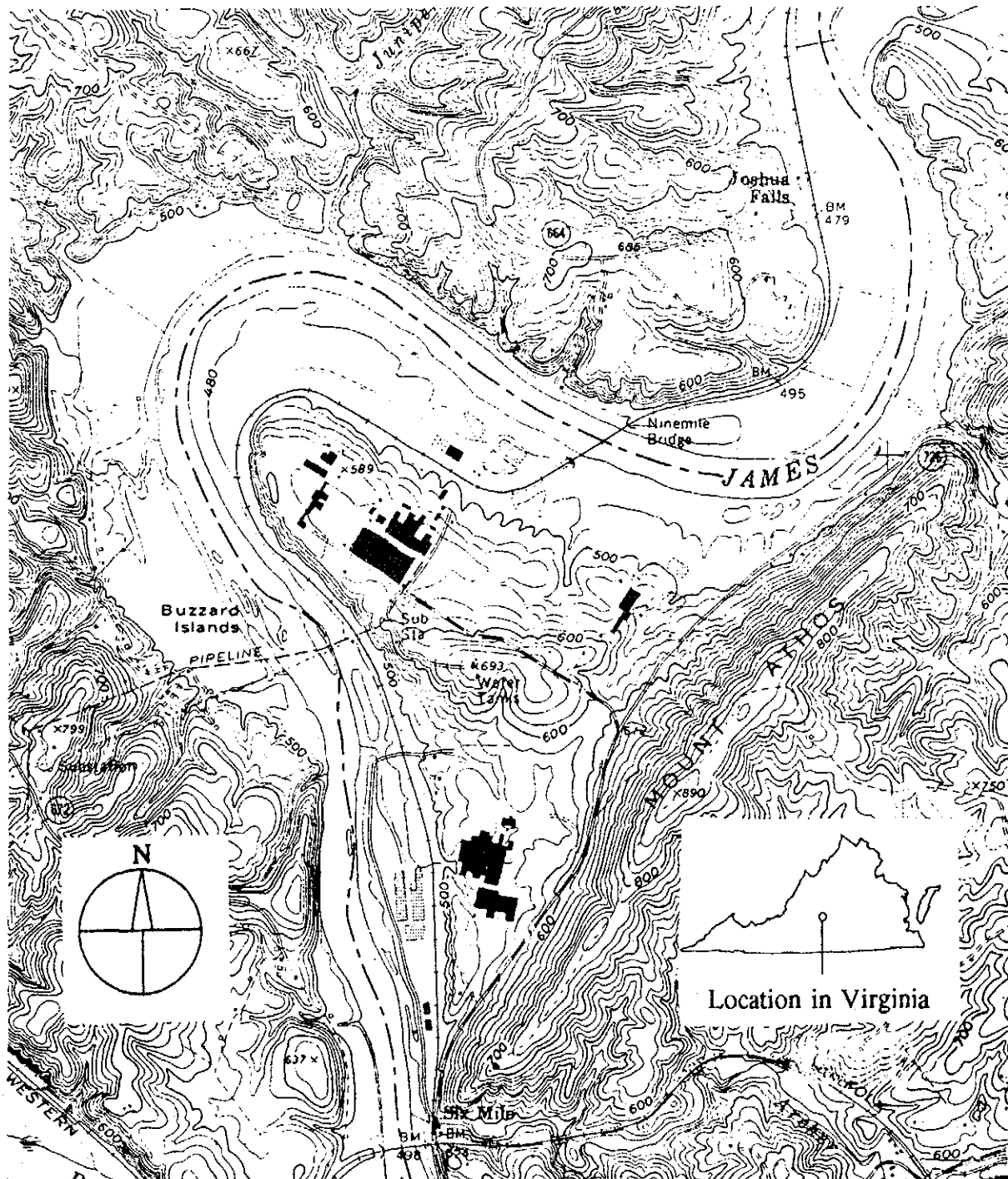
Richmond and Alleghany Railroad Company. Papers. Location: Chesapeake and Ohio

JOSHUA FALLS BRIDGE
(CSX Transportation Bridge No. 1375-A)
HAER No. VA-93 (Page 14)

Historical Society, Clifton Forge, Virginia. Although these papers were perused for information on the Joshua Falls Bridge, the lack of any guide or cataloguing system made a thorough investigation impossihle.

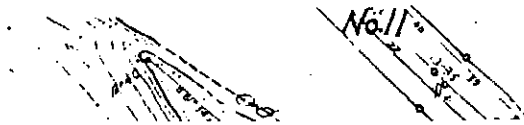
JOSHUA FALLS BRIDGE
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Fig. 1. Detail of 1986 Kelly, Va. USGS quadrangle map showing bridge and surroundings.
Scale: 1" = 2,000'.



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Fig. 2. Detail of 1916 "Right of Way and Track Map, The Chesapeake and Ohio Railway Company, James River Line, Station 874+05 to Station 979+0." Scale: 1" = approx. 300'.



Source of original drawing: Chesapeake and Ohio Railway. Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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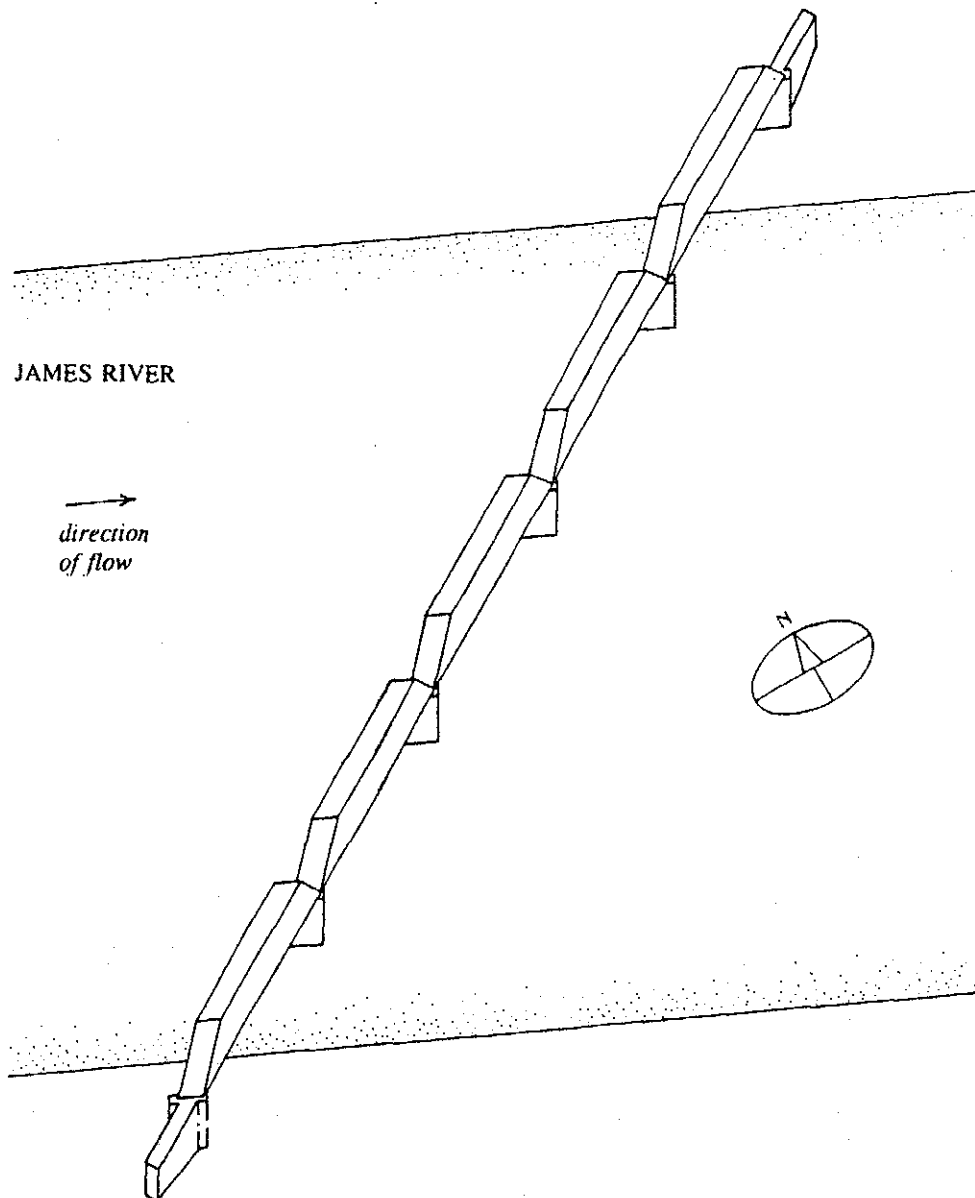
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Fig. 3. Isometric diagram of bridge. No scale.



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Fig. 4. 1900 drawing "Bridge No. 1375A for 1st Crossing of James River . . ." Dwng. no. 1531.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 5. Detail of 1900 drawing "Erection Diagram, Bridge No. 1375A . . . [Sheet # 12]"
showing plan and elevation of west truss.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 6. Detail of 1900 drawing "Erection Diagram, Bridge No. 1375A . . . [Sheet # 12]"
showing elevation and section of end of typical truss.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 7. 1900 drawing "Bridge No. 1375A: First Crossing of James River . . . Stress Sheet."

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 8. Detail of 1900 drawing "Top Chord Sec'ns, Bridge No. 1375A . . . Sheet # 2" showing sections of typical top chord.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 9. Detail of 1900 drawing "Portal, Top Strut, & Top Laterals, Bridge No. 1375A . . .
Sheet # 4" showing elevation of typical portal.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 10. Detail of 1900 drawing "Floor Beams, Bridge No. 1375A . . . Sheet No. 9"
showing elevation of typical floor beam.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: CSX Transportation, 500 Water St., Jacksonville, FL 32232.

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Fig. 11. Detail of 1941 drawing "Masonry Repairs, West Abutment, Bridge # 1375-A
..." showing reworking of west abutment.

Source of original drawing: Chesapeake and Ohio Railway.

Location of original drawing: ~~CSX Transportation~~, 500 Water St., Jacksonville, FL 32232.

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